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Reno, Nevada 89502

January 15, 2014

Tim Rubald, Program Manager
Sagebrush Ecosystem Program
201 S. Roop Street, #101
Carson City, Nevada 89701

Regarding: Sage grouse predators (ravens, coyotes, humans)

Dear Mr. Rubald

After attending the meeting last week of the Sagebrush Ecosystem Council, I decided to send this letter (and enclosures) regarding human and non-human predators of sage grouse. While the issue of sage grouse predation seems less weighty than complexities of pinion/juniper encroachment of strutting grounds, loss of sagebrush habitat, annual grasses and wild fire alterations to the landscape, fragmentation of sage brush ecosystems, the importance of private lands in Nevada for brood rearing and the like, there is, among some in Nevada, the idea that killing predators represents an easy way forward if not a literal "silver bullet" in preserving sage grouse.

As someone with a long-standing interest in the topic of human and non-human predation regarding wildlife issues, I'm hoping that this background information may be of interest to you and the Council as your deliberations go forward.

Ravens:

Raven predation of sage grouse nests has been a "hot" topic for years, and especially so since Dr. Coates has produced his recent studies. Because he has shown that ravens (one of several non-human potential predators of sage grouse) can and do disturb sage grouse nests.....confirming in a quantitative manner what was already known...his study results have increased calls for more raven poisoning from those who appear to believe that killing predators to increase other wildlife species is sensible and productive. Without debating the

merits (or lack, thereof) of that hypothesis, let me provide background information about raven poisoning in Nevada over the past 20 years.

From the last half of the 1990's until about 10 years ago, Wildlife Services (the quasi-federal predator killing agency) was poisoning several thousand ravens per year....upwards of 8000 or so/maybe more....here in Nevada. That number of ravens being killed represented about 70% of all ravens killed in the entire U.S. by Wildlife Services for that year. When this astonishing rate of raven poisoning was noticed by the conservation community and called to the attention of the U.S. Fish and Wildlife Service (USFWS), the Service, which was already mulling over similar concerns, concurred with us and terminated Nevada Wildlife Service's previously unlimited raven-killing permit.

For a period of time after that....maybe a year or so....Nevada Wildlife Services had no raven killing permit. Subsequently, a limited permit of 1800 raven kills was issued to Wildlife Services, and later raised to 2300 birds. The Nevada Department of Wildlife (NDOW) obtained its own raven killing permit, now at 2500 birds, based upon the sage grouse predicament. NDOW's permit was then made available to Wildlife Services, as the contractor agency, to perform raven poisoning on behalf of NDOW's sage grouse protection projects. In combination, raven killing permits by Wildlife Services and NDOW now total about 4800 birds per year.

It is also true that landowners, land fill operators, airport managers and others can apply for raven killing permits in Nevada. I believe there are such permits issued, though I do not have the kill numbers. In total, they would be much smaller than what Wildlife Services and NDOW have between them.

One of the interesting things about raven killing permits issued by USFWS is item D. of the permit conditions. (See enclosed NDOW permit) Condition D. mandates non-lethal control efforts such as "active hazing, harassment or other non-lethal techniques..." Killing ravens is "restricted to those birds which cannot be scared away by aggressive non-lethal control efforts." Condition D. is "boiler plate" language, present in all raven depredation permits.

So, raven poisoning must be preceded by non-lethal control efforts. While the non-lethal element was (to some extent) disregarded in the past, I understand from recent and past conversations with USFWS personnel that proof of non-lethal efforts....e.g. photographs, sales receipts, etc...may be requested to prove good faith compliance with condition D. of the permit.

USFWS has, in the past, based its depredation permit limits upon a percentage of the estimated state-wide population of ravens. Until recently…using the U.S. Geologic Survey program, Partners In Flight for determining state-wide population estimates…Nevada's raven population was thought to be about 100,000 birds. Using 5% of the state population as the maximum allowable raven kill, raven depredation permits were limited by USFWS to a maximum of 5000 birds, statewide, for any year.

Recently, Partners In Flight has upped the estimate of ravens in Nevada to 190,000 birds. While this might suggest an increase in raven kills allowed by USFWS to 9500 birds (5% of the new total) it is my current understanding that there won't be much of a change in current allowable depredation levels for the foreseeable future. Also, Wildlife Services and NDOW do not, by their very existence, go to the head of the line for obtaining permits. All requests for raven killing permits…e.g. landowners, airport managers…have equal standing and none has priority over others.

So, in summary, raven poisoning has an inglorious history in this state. Exuberance for killing the bird led to restrictions on Nevada Wildlife Services by USFWS. Non-lethal control efforts are an absolute requirement in every raven depredation permit. Furthermore, given a current population estimate of 190,000 birds, trying to poison our way into sage grouse "prosperity"….particularly in view of all the other threats to the bird's existence across the West….is not sensible.

I'll leave any discussion about targeted poisoning of ravens to Dr. Coates and others, though it should be noted that there is evidence that ravens can and do "specialize" in predation activity. Killing ravens which have no interest in sage grouse depredation makes no sense.

Coyotes:

While I'm unaware of anyone who proposes wide-spread killing of coyotes to enhance sage grouse populations, they are an animal generically lumped into all predator killing proposals, and blamed for transgressions that may or may not be theirs. One person from the audience who spoke last Wednesday mentioned coyotes along with ravens as non-human predators needing "to be controlled"…a euphemism for killing the animal….without providing any justification.

As far as I know, I'm the only person who keeps track of coyote-killing in Nevada, albeit in a loose manner since accurate numbers are not fully available. It can be said with

confidence, though, that there are +/- 10,000 coyotes killed EVERY YEAR in our state. Wildlife Services kills about 5000-7000 each year via trapping, poisoning, shooting, and aerial gunning, gassing in dens, snares and other means. Private fur trappers add another 2000-3000 per year depending a bit on pelt prices. Add 10% for all the other killing not easily quantified or reported, and it's likely that some years, 10,000 dead coyotes is fewer than the actual total. (Wildlife Services activity reports and NDOW trapping records are available on an annual basis.)

The number of coyotes killed each year in Nevada is, in a way, meaningless without an idea about the state-wide population of the animal. Wildlife Services, in a NEPA update for the Nevada program about 3 years ago, made the only effort I've seen to estimate a population number for coyotes in Nevada. Their research biologists estimated the Nevada coyote population to be about 100,000 animals.

If true, then 10% of the state's population of coyotes is killed EVERY YEAR. This level of carnage...10,000/year killed by humans....is astonishing to those of the general public who learn of it. Yet, some sportsmen, some ranchers and some farmers dismiss this number as inconsequential and demand even more animals be killed. One sportsman from Elko suggested an alternative to the Nevada Board of Wildlife Commissioners a year or two ago. All that stood in the way of a mule deer population explosion in Nevada in his view was for Wildlife Services to kill the "right" coyotes. (While I jest, he had a point. Both non-human and human predators can and do kill according to certain preferences or special interests.)

Much of the antagonism towards coyotes by sportsmen has to do with their notion that coyotes are in "competition" with sportsmen and are limiting deer herds. Given that NDOW's state-wide mule deer population estimate over the last decade has been steady at about 110,000 animals, we may have essentially the same number of coyotes in the state as we do mule deer. Poetic justice, perhaps, from my point of view.

But that is not the take-home story about coyotes. It turns out that coyotes are able to increase their productivity via larger litters when being killed in an intensive manner. While this phenomenon has been known for decades, it has been disregarded by the management agencies....NDOW, Nevada Board of Wildlife Commissioners, Wildlife Services, and the Department of Agriculture. Vocal constituents just want dead animals. Damn the consequences.

Skeptics might do well to review an NDOW document, Project 14 &15 (enclosed), which documents a 5-year, +/-$400,000, misguided, unsuccessful effort to increase mule deer

herds in Lincoln County by randomly killing coyotes. While deer numbers did not increase over the 5-year span of the project, coyote litter sizes tripled, and the average age of coyotes killed dropped by about half at the end of the project.

The importance of the finding in Project 14 & 15 that the average age of the coyotes being killed dropped noticeably during the study means that more juveniles were being produced. As with humans and other species, unsupervised juveniles can cause trouble in their surroundings.

This leads to another important fact about coyote social structure. Left alone, coyotes form a stable family unit comprised of an alpha male and female and associated sub-adults. Typically, only the alpha female becomes pregnant. Sub adult females do not breed, but help raise the group's pups. Litter sizes are smaller. Coyotes under these conditions are practicing a form of population control for themselves.

Yet, with our failure to take account of what we already know about coyote behavior, we encourage and allow random killing of coyotes. This destroys or prevents such stable social groupings, allows juvenile female coyotes to breed, produces more juveniles who are not raised in a stable social group, have no knowledge of how to make a living on a home range because they've never had one, and may cause trouble for agricultural interests, pets, or whatever they encounter. Then, we complain, having had a hand in the creation of the very trouble that now concerns us.

So, it is clear that randomly killing coyotes to "control" them is nothing more than a waste of money, a way to create more troublesome juvenile coyotes, and, in my view, unnecessary destruction of public property without good reason. Therefore, any proposals to do so deserve scrutiny and skepticism.

Humans:

It is not logical...at least from the point of view of those of us who do not hunt or trap... to discuss known or suspected sage grouse predators without talking about human predation of the bird. Human predators are, by sheer absolute numbers, the most prolific killers of sage grouse in Nevada.

In the past 30 years (1983-present), Nevada hunters have killed at least 207,713 birds. Since the year 2000, that toll is 60,322. (See enclosed NDOW data sheet.) One can SPECULATE about ravens pilfering sage grouse nests, and wonder about the impacts on

the bird going forward, but it is ABSOLUTELY CERTAIN that humans have killed over 200,000 sage grouse in this state in the past 30 years. The numbers are impressive!!

To be fair, if one is going to speculate about raven nest predation and what that means for future lost sage grouse production, one must ask the same question about all the sage hens that were killed by hunters, and the future productivity that was lost to the species by their deaths. What is good for the goose must be good for the gander. It is not logical to argue otherwise.

Putting it another way, I've included NDOW's "In Defense of Sage Grouse Hunting In Nevada" for discussion purposes. I will disregard most of it since I'm not debating hunting as a general issue in this letter. I direct your attention to the last half of the first paragraph where sage grouse hunting in Nevada is defended as being "compensatory" rather than "additive" without any supporting evidence.

This unsupported assertion is commonly applied to all hunting practices (human predation), and represents, in my experience, a hypothesis taught in college to aspiring wildlife biologists and wildlife managers, and then perpetuated in fish and game agencies without much evidence to support it.

Its usefulness is that it lets hunters off the hook since it means that any animal or bird killed by hunters, now and forever, would have died anyway without further reproductive activity, would have died of disease, predation or old age, or some other cause. And/or by virtue of its death at the hands of a human predator, more resources are available for those of the species which remain behind, leading to greater reproductive capability…e.g. more twins, more chicks, less malnutrition/miscarriages, better fawn and chick survival and so on.

On the other hand, every sage grouse egg pilfered by a raven, a badger, a skunk, a ground squirrel…..whatever….is regarded as "additive", which invariably (as the theory goes) leads to an unrecoverable loss of at least one individual, if not several future generations, of sage grouse, that there are no environmental benefits that accrue to remaining live members of the sage grouse community (by having one less mouth to feed in available habitat) and helps push the population into further decline.

So a hunter can kill a perfectly healthy sage hen, capable of producing several new generations of chicks, and be "compensatory" about it, while a raven, eating an egg, is always "additive" and does more damage to the species than the hunter.

I cannot help but raise an eyebrow at this utterly absurd set of notions since there is no logic to it that is understandable by any of us who are not steeped in the mythology of wildlife management. (Actually, I'm pretty well "steeped", since I've attended Wildlife Commission meetings for nearly 40 years.)

By the way, I'm familiar with the contention of NDOW biologists that useful information comes via examination of wings taken from birds killed by hunters. I do not dispute this. I do know that it is not necessary to kill animals to learn something of value about them.

I also know the "stench" of hypocrisy that surrounds the continued hunting of sage grouse in the face of all the "doom and gloom" predictions that are in the press these days, speculating about how life as we know it in the West will end should the bird receive ESA listing. Add to that the dire predictions of future hardship by ranchers, farmers, energy producers, miners, and the rest. Yet, sportsmen can (and should?) continue to kill thousands of sage grouse every year with impunity? Remarkable! The non-hunting, non-trapping public clearly sees the hypocrisy and is perplexed.

It is my recommendation that the Council take a close look at sage grouse hunting, and hopefully arrive at the sensible conclusion that it is time to do away with this significant source of sage grouse mortality in Nevada.

Alternatively, wouldn't it be nice if NDOW hosted a sage grouse hunt each year, but nobody showed up for it.

I plan on attending your meeting of January 23rd, and also February 13th. If anyone who reads this has any questions or comments, I'd be happy to respond.

Sincerely

Don Molde

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IN DEFENSE OF SAGE-GROUSE HUNTING IN NEVADA

Sage-grouse hunting provides a traditional recreation opportunity that is considered an appropriate use of wildlife resources when managed correctly. One of the goals of all State Wildlife Agencies is to manage for healthy populations of game fish and terrestrial game species. These programs are obviously considered successful when they support fishable and huntable populations of game species. Additionally, an underlying premise for State Wildlife Agencies to consider, especially for upland game populations, is whether or not hunter harvest is compensatory or additive in relation to natural sources of mortality. Under the appropriate management framework, mortality from sage-grouse hunting is considered compensatory to natural sources rather than additive. In other words, the take from hunting would be deemed additive when it contributes to a population decline by killing individuals above and beyond that which would have died from natural causes such as predation. It is the goal of the Nevada Department of Wildlife (NDOW) to avoid hunter induced mortality that would be additive to natural causes.

In 2010, the U.S. Fish and Wildlife Service identified habitat fragmentation, loss of habitat and the lack of regulatory mechanisms as key threats to the future of our sage-grouse resources. The "lack of regulatory mechanisms" refers to existing measures put in place to conserve the species habitat. Sage-grouse, as their name implies, depend upon sagebrush communities and the overall health of these sagebrush contributes to their productivity and survival. They are considered a landscape scale species, meaning that they need large areas to carry out their life cycle processes as they move from one seasonal habitat to another. There is no question that the amount of suitable sage-grouse habitat in Nevada has decreased over the last few decades, mainly due to major wildfires.

NDOW scrutinizes sage-grouse hunting seasons and is conservative when it comes to recommending season length and bag limits for the species. NDOW follows guidelines established by the Western Association of Fish and Wildlife Agencies (WAFWA) that suggest hunter harvest should not exceed 10% of the estimated fall population and populations should not be hunted where less than 300 individuals comprise the breeding population. Since 2004, the statewide harvest of sage-grouse during the hunting season has been between 2% and 6% of the estimated fall population annually. NDOW has closed sage-grouse seasons in five counties including 23 separate hunt units since 1997. Additionally, the WAFWA guidelines suggest that sage-grouse seasons be relatively short (1-4 week season) with a low bag limit (1-2 birds per day). The season in Nevada has generally fluctuated between 10 to 15 days for most areas and the bag limit has remained at 2 per day and 4 birds in possession.

Aside from the aforementioned guidelines, NDOW relies on research projects conducted in Nevada that shed light on hunting mortality. For example, a long-term research project in Eureka County being conducted by the University of Nevada, Reno on the effects of a utility scale transmission line on sage-grouse population dynamics has determined that the total female mortality associated with hunting was 2.2% over the course of three years. In a separate study conducted in the Montana Mountains of Humboldt County, Sedinger et al. (2010) found no support for an additive effect of hunter harvest on survival. These results suggest that the effect of hunter harvest is very small.

An ancillary benefit of the hunting season is that it allows NDOW an opportunity to collect important population demographic data. Each year, NDOW collects wings from hunter harvested birds. Data collected from these wings are used to help estimate fall population size in specific areas. Closer examination of wings classified as adult hens also allows NDOW to determine whether or not the bird nested successfully (hatched eggs) during the previous breeding season, which can help determine population health and formulate future management recommendations.

Additionally, hunting creates a constituency of sage-grouse advocates who are interested in seeing that the needs of sage-grouse populations are met. Westerners are generally supportive of the multiple-use management philosophy on public lands. Regulated hunting, as recommended by state and local conservation plans, is a sustainable multiple-use activity (Christiansen 2008). A primary benefit of sage-grouse hunting is that NDOW is able to utilize hunting license sales as match for Pittman-Robertson Wildlife Restoration Act (PR) federal-aid dollars. For the 10-year period from 2003-2012, sportsman's dollars have allowed NDOW to access $4.7 million ($3.53 million federal dollars and $1.18 million state share). This funding allows NDOW to monitor populations through lek counts, wing collection and radio-marking investigations, conduct habitat improvement and restoration projects (including wildfire rehabilitation), and conduct research to improve management strategies for the species and better understand factors that may be limiting populations. All activities associated with this funding are reported annually in a Job Progress Report format and are available on the NDOW website located at http://www.ndow.org/wild/conservation/sg.

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

FEDERAL FISH AND WILDLIFE PERMIT

2. AUTHORITY-STATUTES
16 USC 703-712

REGULATIONS
50 CFR Part 13
50 CFR 21.41

1. PERMITTEE

NEVADA DIVISION OF WILDLIFE
dba NDOW
1100 VALLEY RD
RENO, NV 89512
U.S.A.

3. NUMBER
MB37116A-0

4. RENEWABLE	5. MAY COPY
☒ YES ☐ NO	☒ YES ☐ NO
6. EFFECTIVE 03/06/2013	7. EXPIRES 02/28/2014

8. NAME AND TITLE OF PRINCIPAL OFFICER *(If #1 is a business)*
SHAWN P ESPINOSA
UPLAND GAME BIOLOGIST

9. TYPE OF PERMIT
DEPREDATION

10. LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED
Clark, Elko, Humboldt, Lander, Lincoln, Lyon, Washoe, and White Pine Counties
NEVADA

11. CONDITIONS AND AUTHORIZATIONS:

A. GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL, OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS, INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS.

B. THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN, STATE, LOCAL, TRIBAL, OR OTHER FEDERAL LAW.

C. VALID FOR USE BY PERMITTEE NAMED ABOVE.

D. You are authorized to lethally take **2500 Common Ravens** for protection of Sage Grouse and other game (waterfowl, turkey, and pheasant) using a rifle with non-toxic ammo, a shotgun with non-toxic shot shells (i.e. steel), an air rifle with non-toxic pellets (non-lead), and/or DRC 1339. Lethal take is not to be the primary means of control. Killing is restricted to those birds which cannot be scared away by aggressive non-lethal control efforts. Active hazing, harassment or other non-lethal techniques must continue in conjunction with any lethal take of migratory birds.

E. Birds may be temporarily hung to attempt to scare away depredating birds prior to final disposition (see Condition "8" of attached standard conditions). It is strongly encouraged that efforts are conducted out-of-view of the public and appropriate outreach is implemented to mediate potential public concern.

F. Anyone who takes birds under the authority of this permit must follow the American Veterinary Medical Association Guidelines on Euthanasia (http://www.avma.org/issues/animal_welfare/euthanasia.pdf).

G. No bird shall be killed in any manner not authorized by the State of Nevada or local ordinance.

☒ ADDITIONAL CONDITIONS AND AUTHORIZATIONS ALSO APPLY

12. REPORTING REQUIREMENTS
ANNUAL REPORT DUE: 03/10
You must submit a report to your Regional Migratory Bird Permit Office, even if you had no activity. Report form is at: www.fws.gov/forms/3-202-9.pdf.

ISSUED BY	TITLE	DATE
	WILDLIFE BIOLOGIST, REGION 8	03/06/2013

H. Records must be kept of the number of birds killed by month.

I. Subpermittees include: designated employees of USDA/APHIS/Wildlife Services and any other person who is (1) employed by or under contract to you for the activities specified in this permit, or (2) otherwise designated a subpermittee by you in writing, may exercise the authority of this permit.

J. You and any subpermittees must comply with all attached Standard Conditions for Migratory Bird Depredation Permits. **These standard conditions are a continuation of your permit conditions and must remain with your permit.**

For suspected illegal activity, immediately contact USFWS Law Enforcement at: Reno (775) 861-6360

Standard Conditions
Migratory Bird Depredation Permits
50 CFR 21.41

All of the provisions and conditions of the governing regulations at 50 CFR part 13 and 50 CFR part 21.41 are conditions of your permit. Failure to comply with the conditions of your permit could be cause for suspension of the permit. The standard conditions below are a continuation of your permit conditions and must remain with your permit. If you have questions regarding these conditions, refer to the regulations or, if necessary, contact your migratory bird permit issuing office. For copies of the regulations and forms, or to obtain contact information for your issuing office, visit: http://www.fws.gov/migratorybirds/mbpermits.html.

1. To minimize the lethal take of migratory birds, you are required to continually apply non-lethal methods of harassment in conjunction with lethal control.
   [*Note: Explosive Pest Control Devices (EPCDs) are regulated by the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF). If you plan to use EPCDs, you require a Federal explosives permit, unless you are exempt under 27 CFR 555.141. Information and contacts may be found at www.atf.gov/explosives/how-to/become-an-fel.htm.*]

2. Shotguns used to take migratory birds can be no larger than 10-gauge and must be fired from the shoulder. You must use nontoxic shot listed in 50 CFR 20.21(j).

3. You may not use blinds, pits, or other means of concealment, decoys, duck calls, or other devices to lure or entice migratory birds into gun range.

4. You are not authorized to take, capture, harass, or disturb bald eagles or golden eagles, or species listed as threatened or endangered under the Endangered Species Act found in 50 CFR 17, without additional authorization.

   For a list of threatened and endangered species in your state, visit the U.S. Fish and Wildlife Service's Threatened and Endangered Species System (TESS) at: http://www.fws.gov/endangered.

5. If you encounter a migratory bird with a Federal band issued by the U.S. Geological Survey Bird Banding Laboratory, Laurel, MD, report the band number to 1-800-327-BAND (2263) or http://www.reportband.gov.

6. This permit does not authorize take or release of any migratory birds, nests, or eggs on Federal lands without additional prior written authorization from the applicable Federal agency, or on State lands or other public or private property without prior written permission or permits from the landowner or custodian.

7. Unless otherwise specified on the face of the permit, migratory birds, nests, or eggs taken under this permit must be:
   (a) turned over to the U.S. Department of Agriculture for official purposes, or
   (b) donated to a public educational or scientific institution as defined by 50 CFR 10, or
   (c) completely destroyed by burial or incineration, or
   (d) with prior approval from the permit issuing office, donated to persons authorized by permit or regulation to possess them.

8. A subpermittee is an individual to whom you have provided written authorization to conduct some or all of the permitted activities in your absence. Subpermittees must be at least 18 years of age. As the permittee, you are legally responsible for ensuring that your subpermittees are adequately trained and adhere to the terms of your permit. You are responsible for maintaining current records of who you have designated as a subpermittee, including copies of designation letters you have provided.

9. You and any subpermittees must carry a legible copy of this permit, *including these Standard Conditions*, and display it upon request whenever you are exercising its authority.

10. You must maintain records as required in 50 CFR 13.46 and 50 CFR 21.41. All records relating to the permitted activities must be kept at the location indicated in writing by you to the migratory bird permit issuing office.

11. Acceptance of this permit authorizes the U.S. Fish and Wildlife Service to inspect any wildlife held, and to audit or copy any permits, books, or records required to be kept by the permit and governing regulations.

12. You may not conduct the activities authorized by this permit if doing so would violate the laws of the applicable State, county, municipal or tribal government or any other applicable law.

(DPRD - 12/3/2011)

SUMMARY OF STATEWIDE UPLAND GAME HARVEST 1967-2011
From Post-season Questionnaire

Year	Sage Grouse	Hunters	Blue Grouse	Hunters	Chukar Partridge	Hunters	Hungarian Partridge	Hunters
1967	7,284	4,584	408	564	48,984	8,376	ND	ND
1968	11,765	5,499	975	559	78,064	10,047	ND	ND
1969	23,270	7,605	767	611	124,353	14,536	ND	ND
1970	23,775	9,180	645	570	16,886	18,615	ND	ND
1971	20,805	7,845	660	645	155,895	17,127	ND	ND
1972	17,686	9,099	1,301	882	75,520	14,116	ND	ND
1973	24,930	8,536	2,529	1,237	131,608	13,936	ND	ND
1974	22,924	9,348	3,409	1,696	161,813	17,952	9,625	2,160
1975	16,376	8,331	2,168	1,534	89,408	14,292	2,671	1,185
1976	13,902	5,977	1,752	1,047	56,440	9,626	2,020	870
1977	7,561	4,230	2,257	1,164	52,245	7,853	1,503	606
1978	17,693	6,647	2,663	1,396	108,775	12,296	2,234	796
1979	28,228	8,090	3,123	1,684	151,270	13,960	2,665	1,042
1980	14,648	5,895	1,824	1,112	218,965	15,481	4,895	1,465
1981	15,522	6,731	2,916	1,560	84,498	11,486	8,671	1,469
1982	13,015	6,150	1,792	1,501	55,454	10,738	2,151	1,257
1983	14,495	6,297	939	1,379	79,222	10,979	2,999	1,105
1984	11,555	5,960	1,183	1,043	52,243	9,264	3,299	1,079
1985	ND	ND	1,125	1,063	19,514	6,842	1,271	484
1986	3,967	2,361	1,897	950	43,555	9,325	1,802	774
1987	9,104	3,866	1,694	1,063	52,640	10,200	2,609	983
1988	7,564	3,722	1,856	1,317	101,194	13,065	3,888	1,260
1989	9,445	4,320	2,303	1,225	82,464	14,545	1,655	847
1990	13,697	5,331	2,357	1,291	75,834	10,941	3,829	1,247
1991	13,371	5,564	1,161	1,285	46,700	11,364	1,526	858
1992	12,871	5,126	3,179	1,422	46,780	9,206	750	489
1993	9,782	4,352	1,490	1,141	24,232	7,519	368	377
1994	9,004	4,238	847	796	28,563	6,871	938	275
1995	7,529	4,042	1,606	1,127	62,009	11,613	1,985	658
1996	8,111	3,906	1,969	919	61,972	11,041	1,455	760
1997	5,125	3,471	1,105	1,113	36,950	9,178	1,055	480
1998	5,723	3,277	1,550	857	62,289	10,742	2,830	750
1999	6,070	3,097	1,702	997	105,655	15,586	8,759	2,069
2000	4,728	2,520	925	844	61,310	11,721	4,801	992
2001	2,691	1,708	1,168	666	54,350	8,905	2,223	697
2002	3,940	2,412	1,064	801	72,545	10,722	1,504	789
2003	4,557	2,177	1,305	688	115,738	12,491	2,266	892
2004	5,244	2,194	833	523	76,081	9,134	1,482	523
2005	3,175	1,526	2,046	1,268	120,135	14,727	2,767	1,613
2006	3,701	1,981	2,822	1,987	104,408	15,654	4,334	1,866
2007	4,897	3,197	1,699	1,643	61,153	14,448	1,775	1,114
2008	5,775	3,271	1,936	1,670	61,307	11,735	1,334	1,023
2009	8,944	4,461	2,807	1,878	76,851	14,197	2,272	1,438
2010	7,353	3,827	1,599	1,375	83,660	14,770	3,656	1,300
2011	**5,295**	**2,055**	**1,084**	**864**	**105,047**	**11,273**	**3,592**	**1,095**

NEVADA DEPARTMENT OF WILDLIFE

Projects 14 &15

Coyote Removal For Deer Enhancement

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Abstract

We quantified the effects of 5 years of coyote removal in Game Management Units 222 and 231, Lincoln Co., NV during fiscal years (FY) 2003-2008. We summarized trends in coyote age and population structure using data obtained from tooth-age analysis (cementum) of teeth taken from harvested coyotes by Wildlife Services. Mean age of coyotes declined throughout the experimental period in GMU 231 as a result of additively removing coyotes by aerial gunning and ground removals each year. Also, juvenile to adult ratios significantly increased by the end of the experimental period as well as the number of adult males to adult females in the population. Fawn:doe and fawn:adult ratios were not significantly different in years prior to coyote removal compared to years following coyote removal in the experimental areas. Similarly, fawn:doe and fawn:adult ratios were not significantly different in the experimental area (GMU's 222 and 231) compared to an adjacent population of mule deer in Utah (Unit 30a) during the same period. Other factors may have contributed to fawn survival in these areas.

Summary

Coyote Age Stucture

The results of 5 years of coyote removal in Game Management Unit (GMU) 231 and the northern portion of GMU 222 in Eastern Nevada appear to have had significant effects on the population dynamics of coyotes in those respective areas. Mean age of coyotes harvested through ground control measures (trapping, calling, and shooting) decreased in each subsequent year in GMU 231 starting in fiscal year (FY) 2004 and ending in FY 2008 for which the most recent data is available (Table 1, Figure 1). This trend was similar in GMU 222 up to FY 2007, however, age data from FY 2008 proved to be problematic and most likely biased to older aged coyotes due to a procedural mistake resulting in about one third of the harvested coyotes not being aged. Furthermore the pup: adult ratio was also impacted by the removal of coyotes in the experimental area with the average number of pups to adult females taken by ground measures increasing from 0.94 in FY 2004 to 2.92 by the end of FY 2008 (Table 1, Figure 2). A total of 1,124 coyotes of all sex and age class were removed in GMU's 222 and 231 during fiscal years 2004 -2008 (Table 1, Figure 3). The highest total number of coyotes removed in any given year occurred in FY 2007 for GMU 231 and FY 2008 for GMU 222. Density of coyote removal ranged from 0 – 3.47 coyotes/km^2 for the entire experimental area with the most concentrated efforts occurring in GMU 231 (Figures 8-10).

Table 1. Summary of age, sex ratios, and total number of coyotes removed using ground methods (trapping, calling, and shooting) and aerial gunning from fixed wing aircraft in Game Management Units 222 and 231, Lincoln Co. Nevada, for fiscal years (2004 – 2008).

	Fiscal Year				
Ground Removals	**2004**	**2005**	**2006**	**2007**	**2008**
Avg. Age all	2.70	2.73	2.64	1.39	1.90
Avg. Age Unit 231	2.85	2.84	2.56	1.39	1.36
Avg. Age Unit 222	2.47	2.48	2.76	2.21	2.90
Pups/Adult Female	0.94	0.57	1.02	3.50	2.92
Male/Female ratio	0.94	0.64	0.80	0.78	1.50
231 Ground Removals	60	40	97	89	84
222 Ground Removals	39	88	58	58	46
231 Air Removals	-	69	81	96	85
222 Air Removals	-	-	45	30	59
231 Total Removed	60	109	178	185	169
222 Total Removed	39	88	103	88	105
Grand Total	99	197	281	273	274

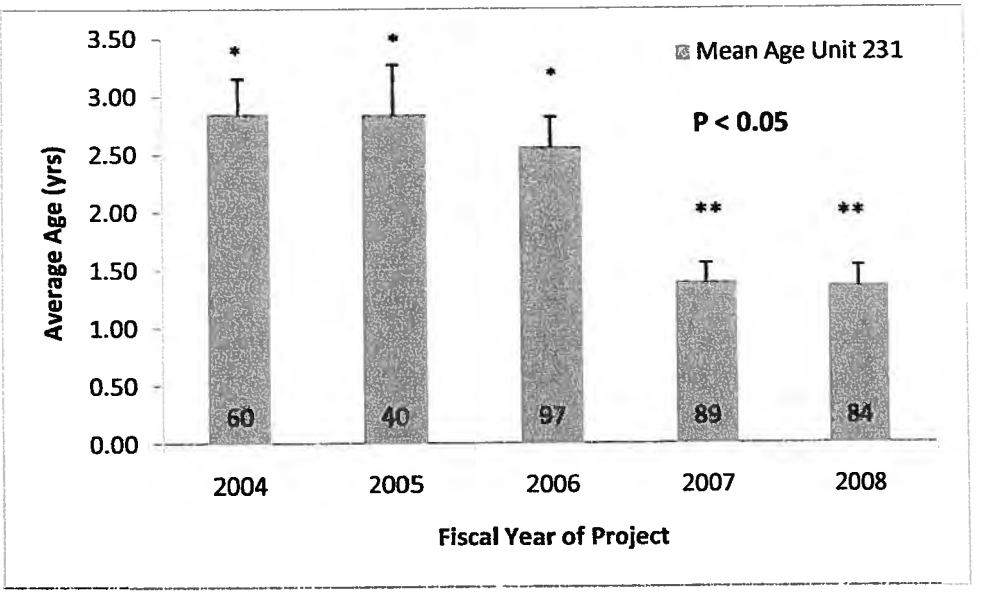

Figure 1. Mean age (+ SE) of coyotes harvested from predator removal experiment in Game Management Unit 231, Nevada for fiscal years (2004-2008). Sample sizes are displayed inside bars and stars above bars indicate significant differences in mean age of treatment year compared using ANOVA and Tukey's HSD for multiple comparisons ($\alpha = 0.05$).

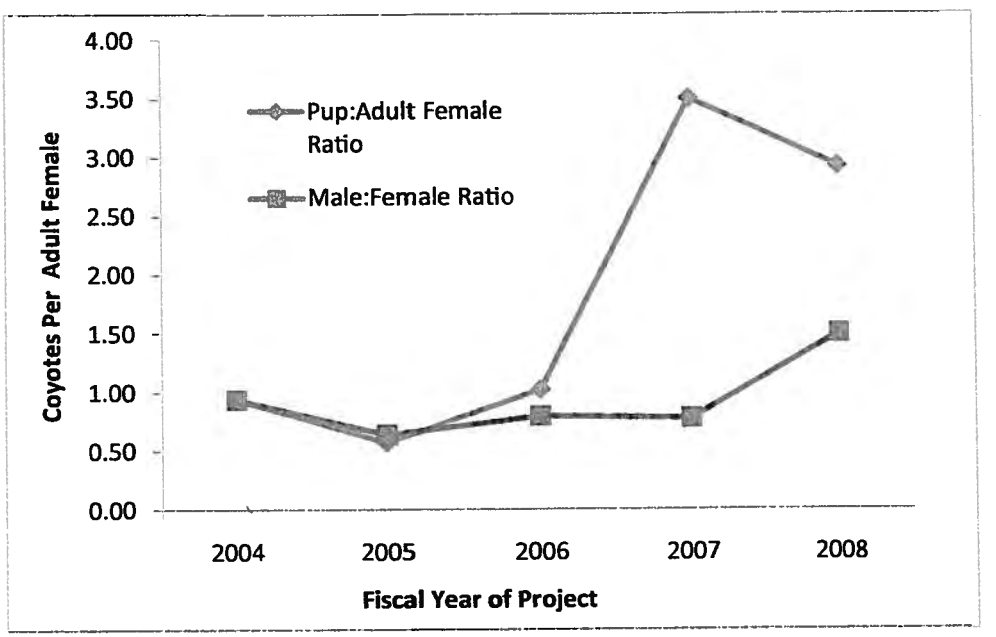

Figure 2. Mean pup to adult female ratio (blue line) and mean male to adult female ratio of coyotes harvested from predator removal experiment in Game Management Unit 231, Nevada for fiscal years (2004-2008).

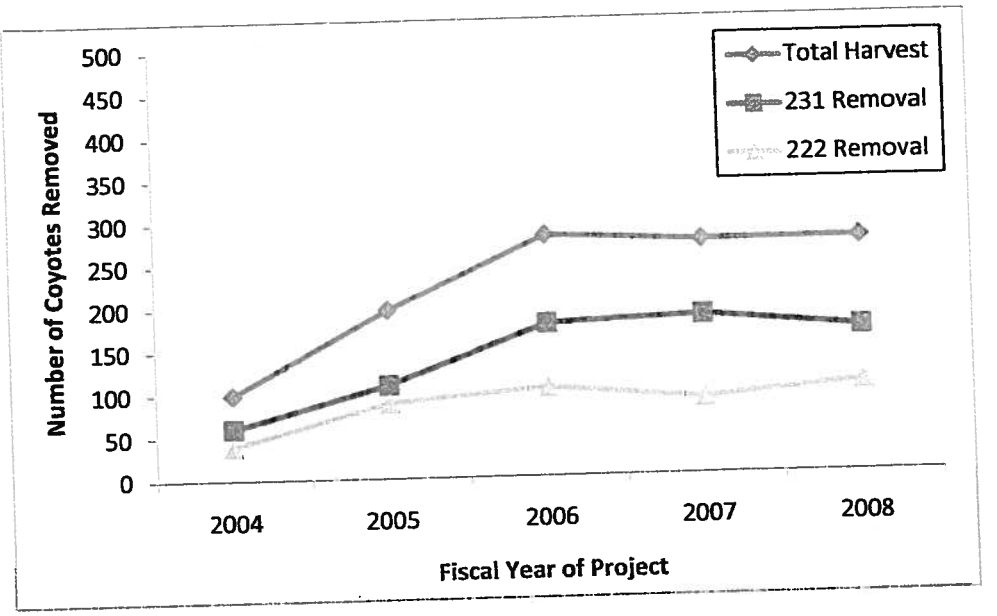

Figure 3. Total number of coyotes removed by ground trapping and aerial gunning in experimental areas of Game Management Unit 222 (green line), GMU 231 (red line), and the total number removed in both areas (blue line) for fiscal years (2004-2008).

Deer Population Response

The results from predator removal in GMU's 222 and 231 appear to have had minimal effects on the population structure of mule deer in those respective units. We compared fawn:doe ratios from post-season surveys conducted in early winter (December) and fawn:adult deer ratios in spring (April) for GMU's 222 and 231 in Nevada using 5 years of pre-removal survey data (1998-2003) and 5 years of post-removal survey data for years (2003-2008). We also compared deer survey data (fawn:doe and fawn:adult ratios) from experimental areas in Nevada (GMU 231 and northern GMU 222) with an adjacent population of mule deer in Utah (GMU 30a) where no predator removal projects occurred (although removal of some coyotes may have occurred for livestock depredation by US Wildlife Services and to enhance survival of neonate mule deer after years of poor fawn recruitment).

No significant differences occurred in fawn:doe ratios post-season (December) prior to start of predator removal between experimental area GMU 231 Nevada and control area GMU 30a Utah (ANOVA $_{unit}$ $F_{1,9}$ = 1.30, P = 0.291). A similar result occurred comparing Spring ratios (fawn:adult) from treatment area (GMU 231) with control area (UT GMU 30a) prior to predator removal (ANOVA $_{unit}$ $F_{1,9}$ = 0.69, P = 0.432).

Fawn to doe and fawn to adult ratios did not significantly differ between treatment area (NV GMU 231) and control area (UT GMU 30a) after predator removal experiment began (2003-2008) (Table 2). Post-season fawn:doe ratios did not significantly differ between control and treatment (ANOVA $_{unit}$ $F_{1,9}$ = 0.005, P = 0.941) nor did Spring fawn:adult ratios (ANOVA $_{unit}$ $F_{1,9}$ = 1.37, P = 0.274, Table 2, Figure 4).

Similarly, when comparing young:adult ratios for pre-treatment years (1997-2002) with post-treatment years (2003-2008) for the treatment area in Nevada (GMU's 222 and 231), no significant differences were found in both post-season data and spring survey data (Table 2, Figures 5,6). Although, when comparing just survey data in GMU 231, where a significant amount of coyote removal occurred

throughout the entire study area, December fawn:doe ratios do approach significance (ANOVA $_{unit}$ $F_{1,9}$ = 4.51, P = 0.066)(Figure 5). However, spring ratios during the same time periods (an indicator of fawn recruitment), do not appear to be significantly different (ANOVA $_{unit}$ $F_{1,9}$ = 1.31, P = 0.281)(Table 2, Figure 5). The same was true when comparing survey data from combined units 222 and 231 for pre-treatment years (1997-2002) with post-treatment survey data (2003-2008) (Table 2, Figure 6).

Although the results from 5 years of coyote removal in experimental areas (GMU's 231 and 222) do not appear to have significantly impacted the recruitment of mule deer fawns, coyote predation on mule deer is likely occurring. Several reasons could explain why the desired results from predator removal were not obtained. First, the deer data collected is very course in nature and lacks statistical power. Deer data are collected only twice per year (post-season and spring) and much variation can occur when surveying mule deer from a helicopter depending on the weather conditions and timing of mule deer migration patterns. Furthermore no survival data exits on mule deer fawns from the time they are born (mid to late June) to the first six months, when coyote predation is most likely to occur. Although mean fawn:doe ratios do appear to be higher overall during years of coyote removal (Table 2) compared to years of pre-treatment, other compounding factors could be affecting fawn survival and recruitment. For instance, the highest number of fawns per 100 does were observed during a post-season survey in year 2005 (87 fawns per 100 does) only 61 fawns per 100 does were observed the following year (post-season), and spring recruitment numbers were the lowest observed in 10 years during years 2004 and 2008 near the beginning and end of the coyote removal project. Other factors such as annual snowpack and spring/summer precipitation may have also confounded the results from the predator removal experiment. For example the high numbers of fawns observed during spring surveys in years 2005-2006 corresponded to record high precipitation for GMU's 222 and 231 in eastern Nevada (Figure 7). The subsequent decline in precipitation for GMU's 222 and 231 following years 2005-2006 corresponded to a drop in population estimate, numbers of fawns observed, and fawn:doe ratios (Figure 7). Coyote predation in this system may have been compensatory mortality rather than additive for years during which coyote removal was applied.

Table 1. Counts of mule deer before and after coyote removal experiment for post-season (December, Fawn:doe) and spring (Fawn:adult) surveys of Nevada game management units 222, 231, and control area in Southwest Desert, Utah (limited removal of coyotes).

	Unit 231 NV Pre Removal (1997-2002)		Unit 30a UT Pre Removal (1997-2002)		
Fawn:doe ratio	Mean	SD	Mean	SD	*P*-value
Post-Season (December)	47.36	8.64	55.5	12.81	**0.291**
Spring (April)	35.39	3.66	39.25	9.64	**0.432**

	Unit 231 NV Predator Removal (2003 -2008)		Unit 30a UT Control (Limited Removal) (03-08)		
Fawn:doe ratio	Mean	SD	Mean	SD	*P*-value
Post-Season (December)	62.9	13.92	63.5	8.34	**0.941**
Spring (April)	42.00	12.34	49.50	6.85	**0.274**

	Unit 231 Nevada Pre-Removal (1997-2002)		Unit 231 Nevada Post-Removal (2003-2008)		
Fawn:doe ratio	Mean	SD	Mean	SD	*P*-value
Post-Season (December)	47.36	8.64	62.94	13.93	**0.066**
Spring (April)	35.40	3.66	42.00	12.35	**0.284**

	Units 222, 231 NV Pre-Removal (1997-2002)		Units 222, 231 NV Post-Removal (2003-2008)		
Fawn:doe ratio	Mean	SD	Mean	SD	*P*-value
Post-Season (December)	50.64	7.32	57.87	11.78	**0.116**
Spring (April)	36.77	3.35	40.3	11.25	**0.354**

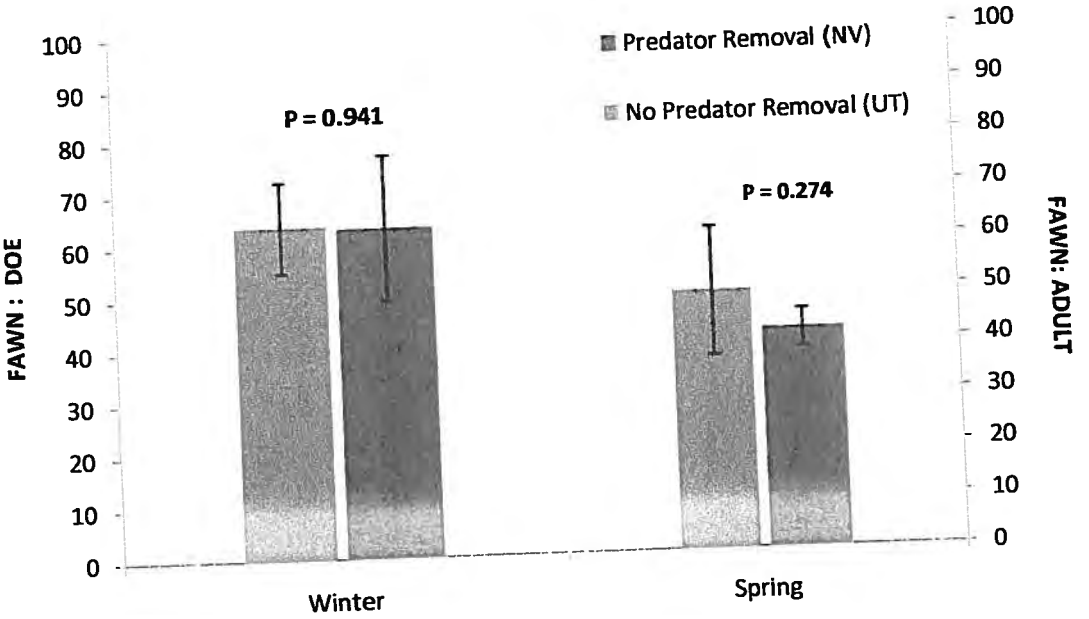

Figure 4. Mean ratio of mule deer fawns per 100 adult does (Winter), and mule deer fawns per 100 adults (Spring). P-values are results from ANOVA comparing fawn: doe (or fawn: adult) ratios in treatment area (Unit 231, NV) with an adjacent area of no predator removals (Unit 30a, UT). Error bars indicate +/- 1 standard deviation.

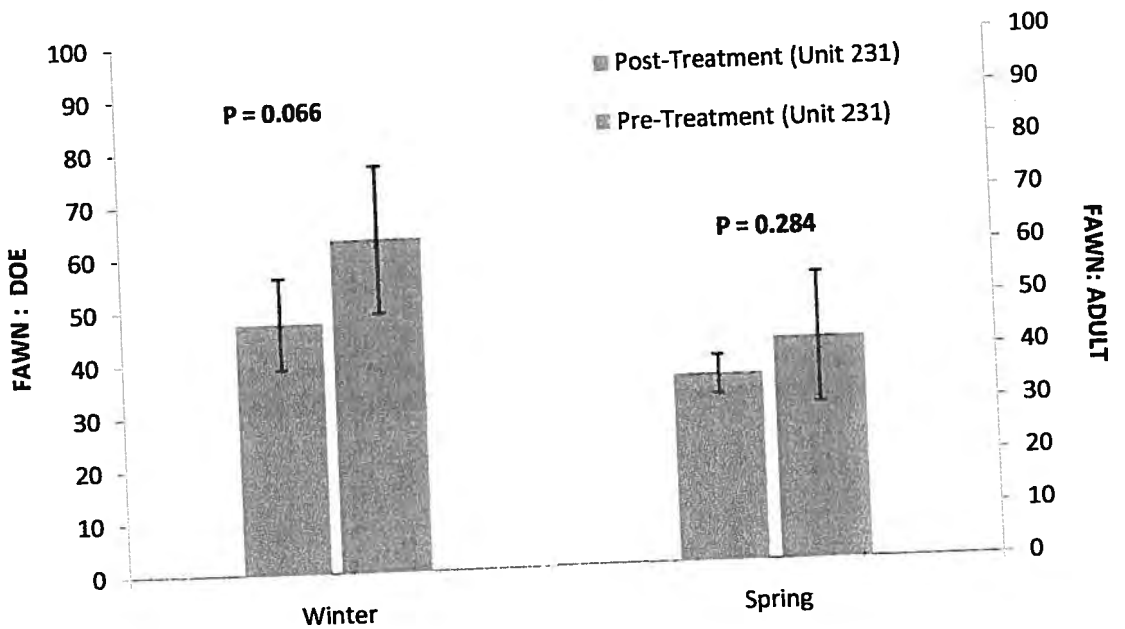

Figure 5. Mean ratio of mule deer fawns per 100 adult does (Winter), and mule deer fawns per 100 adults (Spring) in Game Management Unit 231. P-values are from ANOVA comparing fawn: doe (or fawn: adult) ratios during years before treatment (1998-2003) with years after predator control of coyotes was initiated (2003-2008). Error bars indicate +/- 1 standard deviation.

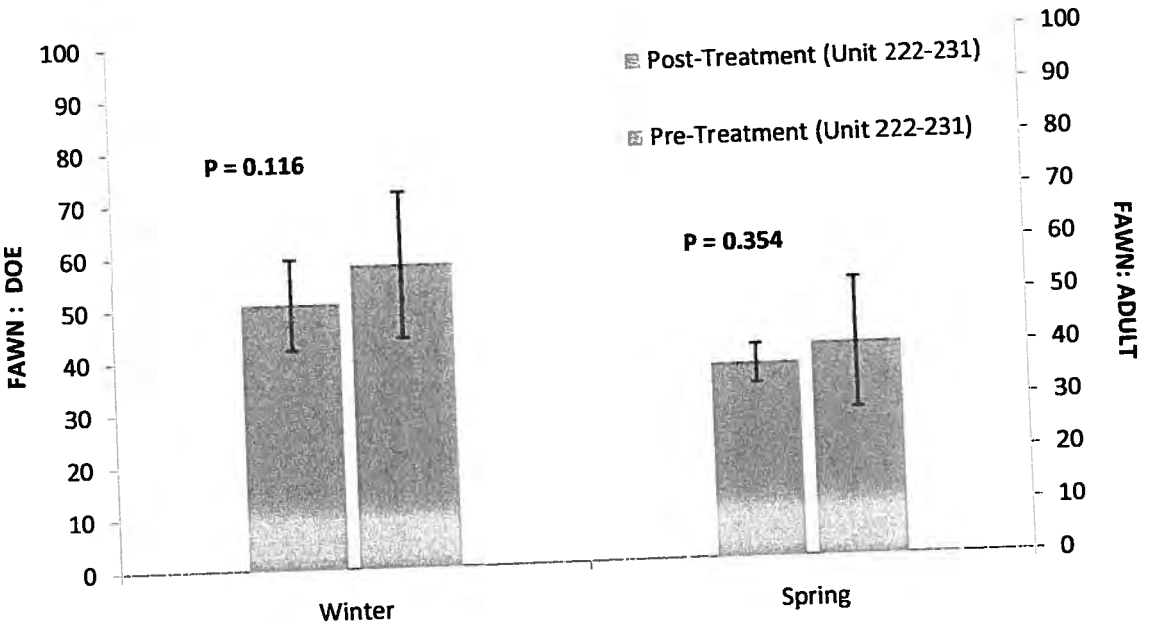

Figure 6. Mean ratio of mule deer fawns per 100 adult does (Winter), and mule deer fawns per 100 adults (Spring) in Game Management Units 222 and 231. P-values are from ANOVA comparing fawn: doe (or fawn: adult) ratios during years before treatment (1997-2002) with years after predator control of coyotes was initiated (2003-2008). Error bars indicate +/- 1 standard deviation.

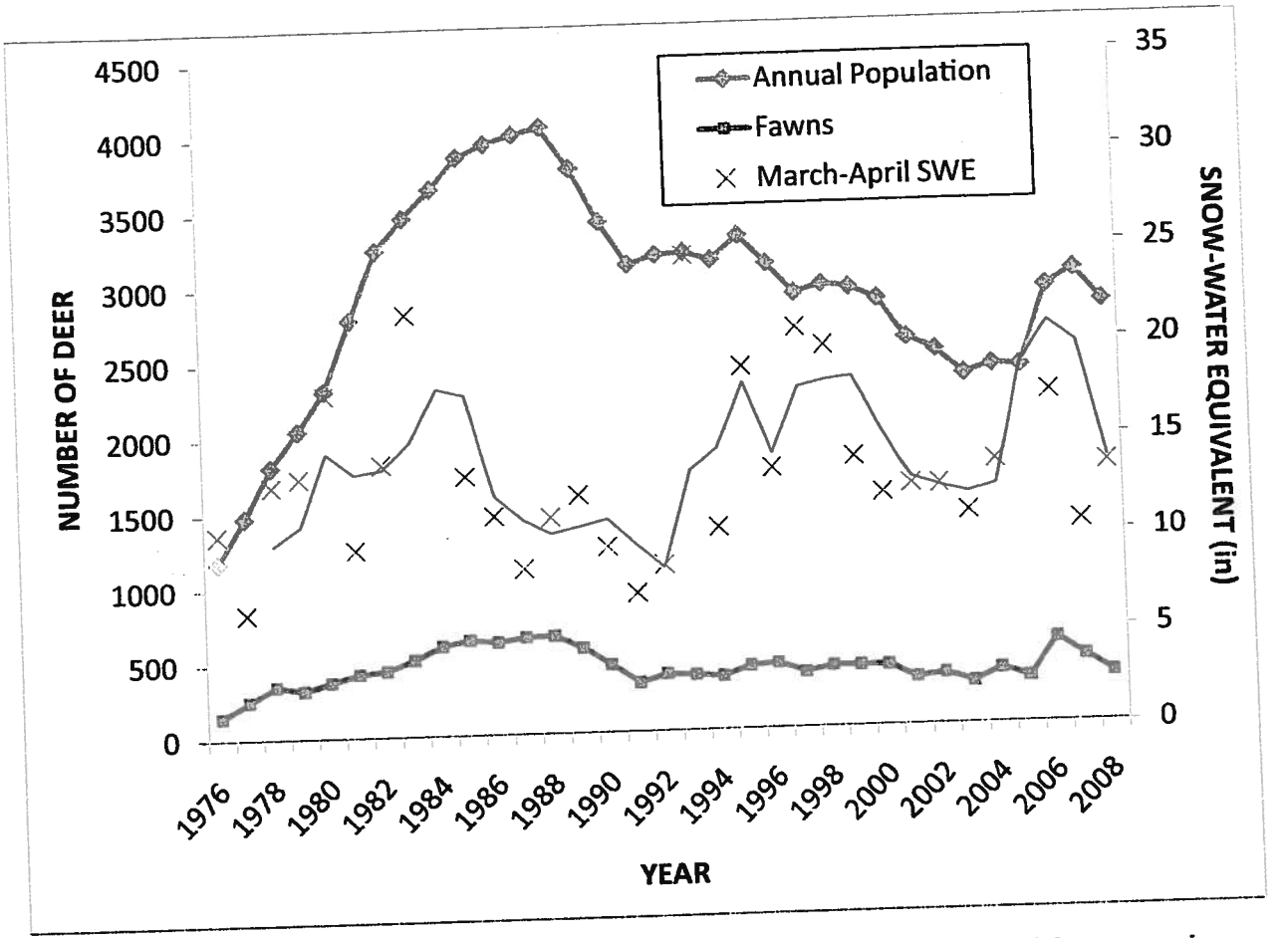

Figure 7. Population estimate of mule deer (blue line) and number of fawns (red line) for surveys in Game Management Unit 231, Nevada, during years 1976-2008. Late winter (March-April) precipitation (snow water equivalent in inches) from Snotel site on Ward Mtn. (39° 8', -114° 57') is plotted on secondary axis during years (1976-2008).

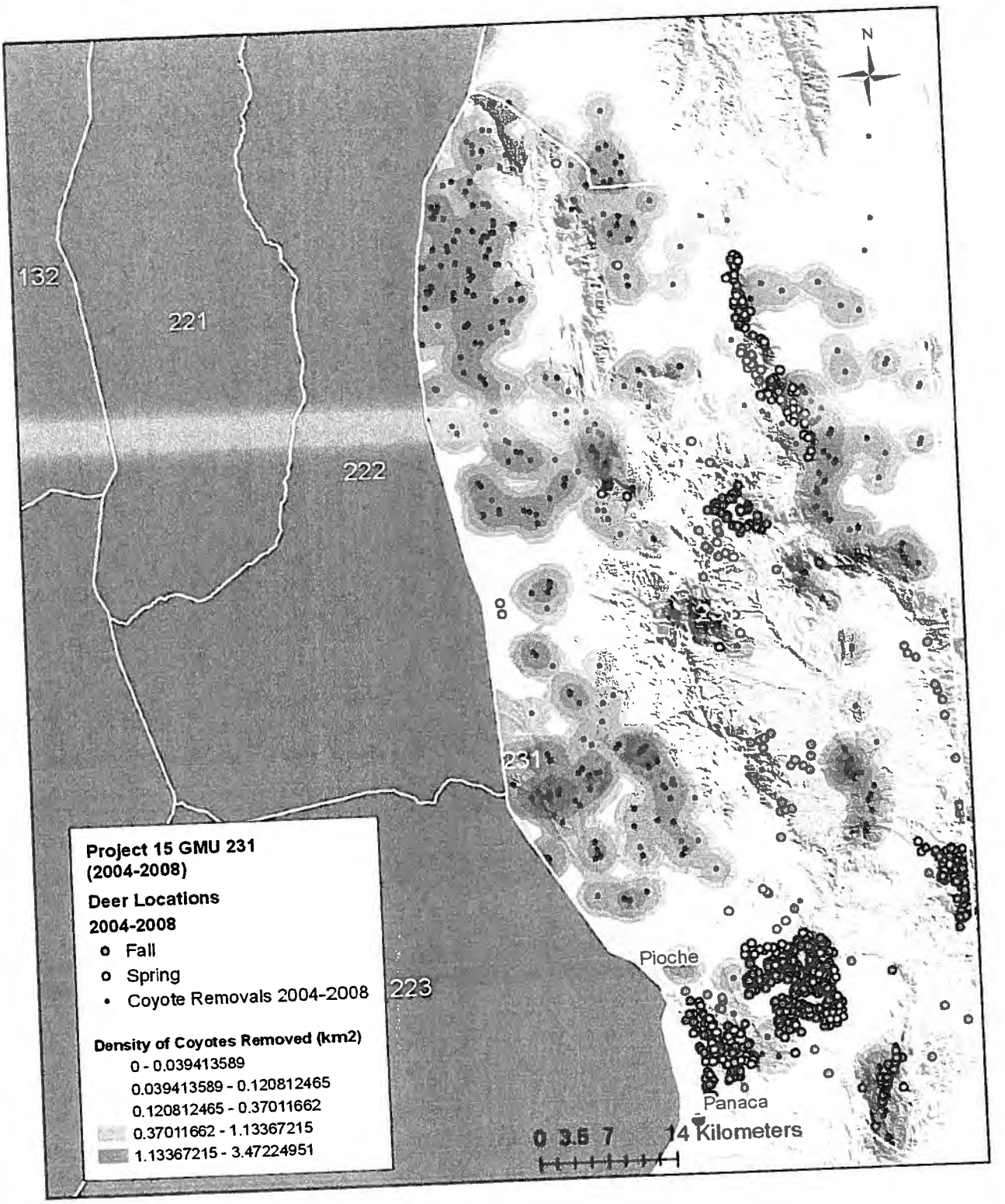

Figure 8. Map showing the experimental treatment area (GMU 231) in Lincoln Co., NV for years 2004-2008. Deer locations are from Fall helicopter surveys (blue dots) and Spring helicopter surveys (green dots). Shaded-polygons are density of coyotes removed (km^2) based on Kriging of coyote points (black dots) and number of coyote removed using both ground and aerial methods.

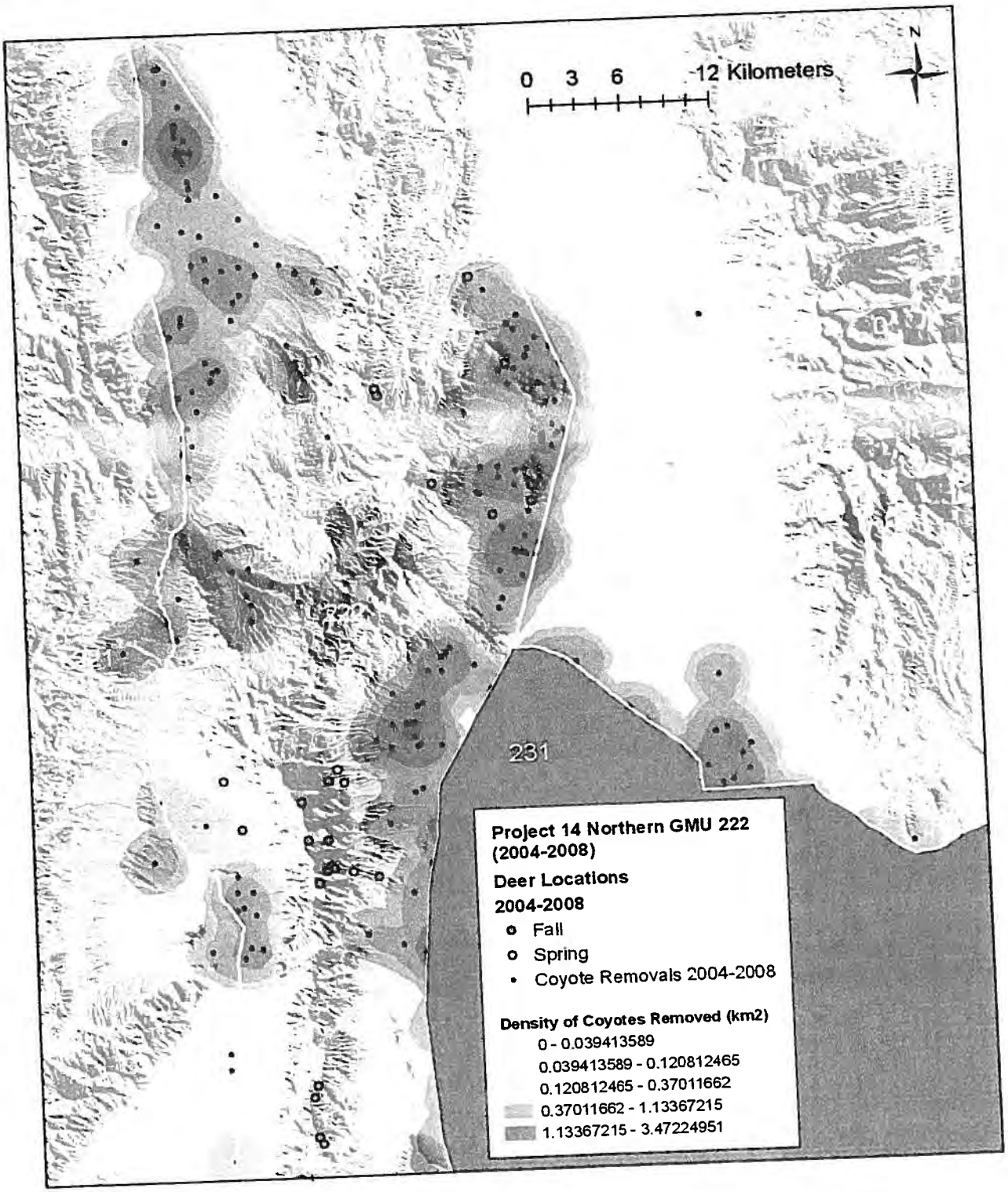

Figure 9. Map showing the experimental treatment area (GMU 222) in Lincoln Co., NV for years 2004-2008. Deer locations are from Fall helicopter surveys (blue dots) and Spring helicopter surveys (green dots). Shaded-polygons are density of coyotes removed (km^2) based on Kriging of coyote points (black dots) and number of coyote removed using both ground and aerial methods.

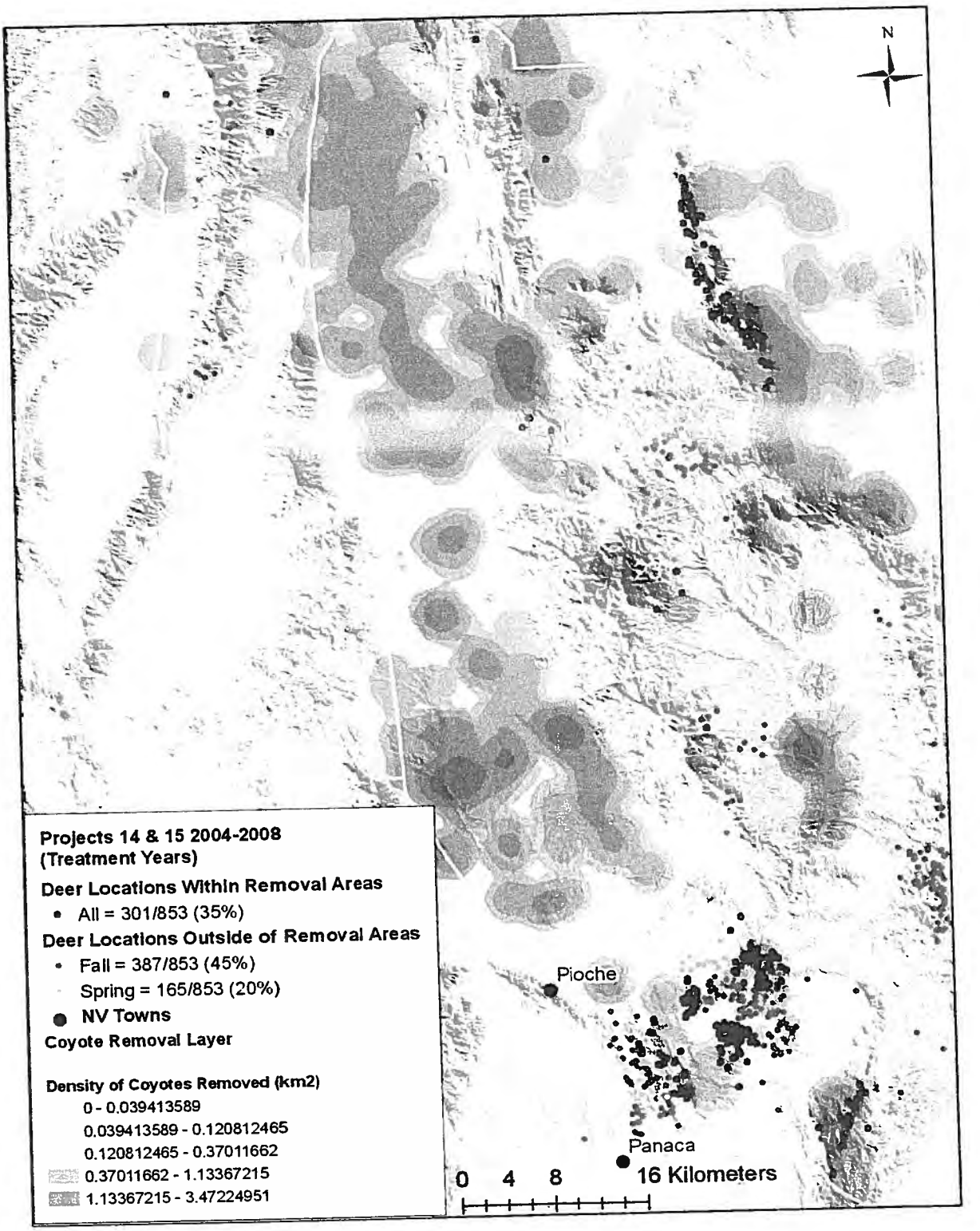

Figure 10. Map showing the effective rate of coyote removals in treatment area (GMU 231) in Lincoln Co., NV for years 2004-2008. Deer locations are from Fall helicopter surveys (blue dots) and Spring helicopter surveys (green dots). Red dots indicate deer locations where greater than 0.12 coyotes per square mile were removed.